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the need of a thorough investigation of the theoretical principles of scientific method? We require less mechanical experiment, less mechanical mathematical calculation, more thought, more philosophy.

With the detailed working out of one example, it is hardly needful to give further examples of the misapplication of mathematical method. The tidal-retardation fallacy is another example more obvious than the last, so clear indeed that to apply these principles in detail is almost pedantic. This example, however, is of special interest in that recent discoveries in radioactivity do not affect the argument. This case it is unnecessary to discuss further, because the mathematicians have already discovered their errors by empirical methods. To elaborate other instances would be superfluous. I can, indeed, best conclude this esay, as I concluded my exposition of main principles, by saying that all acquainted with the multitudinous applications of mathematical reasoning to the complexity of the universe around us can, for themselves, find many other examples.

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DISCUSSION

IF THE BLIND LEAD THE BLIND

A Comment on "Logical Form" in Professor Perry's "Realistic Program"[1]

WHEN will philosophy tire of that Fata Morgana, mathematical method? It is little short of tragic if realism, bearing, as it does, balm for so many ills to which the philosophic flesh is heir, theory of relations, the theory of 'logical constants' or indefinables, the theory of infinity and continuity, and the theory of classes and principal contribution which modern logic is prepared to make to philosophy concerns the form of exact knowledge," and also: "The should be led astray. But I am apprehensive when told that "The systems, concern everything fundamental in philosophy. No philosopher can ignore these and like theories without playing the part of an amateur. . . . For philosophy deals with the same topics as modern logic, but treats *popularly and confusedly* what modern logic treats with the *painstaking thoroughness and exactness* of the expert"[2] [italics mine].

Before these statements become incorporated in a realistic platform, I should like to present the three following theses, with the proviso that it is not as a subordinate philosophic discipline, as a branch of logic, that the investigation in question is invalidated, but only as a discipline peculiarly suited to contribute to the solution of the philosophic problem:

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[1] This Journal, Vol. VII., No. 14, July 7, 1910.

[2] *Loc. cit.*, p. 374.

1. The unclearness of mathematical logic and the lack of agreement in its usages make all efforts to transfer its concepts to philosophy impracticable.
2. Even if these concepts were clearly defined, their specific relation to the logic of mathematics would make the transfer of them a neglect of "the division of the question."[3]
3. Even if these concepts were clearly defined and transferable, the type of method set by mathematics is suitable only for the critical recasting of philosophic systems and not for a developing philosophy such as modern realism.

I

To one who has followed the literature of the subject there is no need of recalling the unclearnesses of the concept in question. M. Lucas de Pesloüan has exhibited them with considerable detail in a series of articles reviewed in this JOURNAL,[4] and prior to 1907 they have furnished MM. Poincaré and Couturat an ever-fresh bone of contention in the pages of the *Revue de Métaphysique et de Morale* —until the latter became too deeply absorbed in the problem of international language to carry on the debate. However, there may be those to whom a few examples will not be amiss:

Logical constants—"Logical constants are all notions definable in terms of the following: . . ." (Russell, "Principles of Mathematics," p. 3).

"Thus pure mathematics must contain no indefinables except logical constants" (*idem,* p. 8).

"The particular notions which appear in the propositions of symbolic logic, and all others definable in terms of these notions, are the logical constants. The number of indefinable logical constants is not great" (*idem,* p. 11).

Logical constants are then definable, indefinable, some definable and some indefinable. And why not both and neither? Incidentally, "A constant is to be something absolutely definite, concerning which there is no ambiguity whatever" (p. 6). It is interesting to collate different passages concerning the specific logical constants.

Infinity—This term has unambiguous definitions in two distinct usages, as ordinal and as cardinal infinity. But starting from these definitions, mathematicians have attained a wealth of paradoxes concerning the transfinite before which Bolzano's *Paradoxien*[5] pale like Halley's comet before the sunrise. M. Poincaré[6] has claimed that they are rooted in the assumption that an infinite collection exists, and I also have tried to make manifest the ambiguity involved in the so-called "existence proof."[7]

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[3] "Exact knowledge must be precisely limited in its application. A disposition in philosophy to employ terms in an unlimited sense, and to make unlimited assertions, is doubtless the principle reason why philosophy at the present time possesses no common body of theory."—Perry, *loc. cit.,* p. 375.

[4] Vol. V., pp. 21–25; Vol. VI., pp. 610–612.

Class—Here is a central difficulty. Peano[8] merely calls a class any collection of objects. Russell[9] says a class is "all the terms satisfying some propositional function." But Jourdain,[10] because of the discovery (!) of nonentities that make null classes look like real classes, puts the question whether every propositional function really does determine a class, and Russell himself[11] in a frantic attempt to get rid of certain paradoxes, proposes (1) a zigzag theory of classes, *i. e.,* some propositional functions define classes and some do not, although apparently you can't tell which is which until you try—and then you are likely to be wrong, (2) a theory of the Limitation of Size, *i. e.,* a class is not a class if it gets too big, and (3) a No-class Theory, *i. e.,* there aren't any such things, anyway. Now,[12] he is proposing a theory of logic based on a theory of types, but Poincaré says[13] that this attempt is very unclear in its distinctions of the finite and transfinite.

This section could be continued *ad infinitum.*

II

The limitation which their specific purpose imposes on these concepts makes them unsuited to philosophy.

Consider such a simple notion as that of equality. Whitehead[14] says: "When two groups of symbols are connected by this sign (=), it is to be understood that one group may be substituted for the other whenever either occurs in the calculus *under conditions for which the assertion of equivalence holds good*" (italics mine), *i. e.,* when you can. This is not on every occasion. For example, let

$$f(x, y) = 0,$$

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[5] B. Bolzano, "Paradoxien des Unendlichen," Berlin, 1889.

[6] *Rev. d. Mét. et d. Mor.,* 1906.

[7] This JOURNAL, Vol. 5, 1908, pp. 628–634.

[8] Notations, "Form. d. Math.," t. I., p. 4, 1904.

[9] *Op. cit.,* p. 19.

[10] "De Infinito in Matematica," *Red. d. Mat.,* t. VIII., 1906.

[11] Reviewed here, 1906, pp. 388–390.

[12] *Am. Journ. of Math.,* Vol. XXX., 1908.

[13] *Rev. d. Mét. et d. Mor.,* 1909, pp. 451–482.

[14] "Universal Algebra," p. 5.

then

$$\frac{dy}{dx} = -\frac{\dfrac{\delta f(x, y}{\delta x}}{\dfrac{\delta f(x, y}{\delta y}},$$

but it is not possible to write $-\frac{\delta o/\delta x}{\delta o/\delta y}$. And this notion is too narrow to be transferred to other mathematical systems.

The mathematical linear continuum is a defined collection of entities such that if they are correlated with possible cuts in a straight line, there will be one-one correspondance, *i. e.*, there will be no entity to which one and only one possible cut does not correspond, and no cut to which one and only one entity does not correspond. For some purposes, then, the mathematical linear continuum is a substitute for the line, and we say the line is, in so far forth, a linear continuum. But no linear continuum, merely taken as such, ever has direction. Direction is a rather significant characteristic of lines. It may be doubted if the mathematical notion of the continuum has the value in philosophy of Aristotle's simpler notion of parts having a common boundary within a whole. There has been one great attempt to take over the mathematical concept of infinity into philosophy—Professor Royce's absolute idealism. Readers of that philosophy can judge of its success. It is certainly an advantage to free oneself of the notion that the infinite is *per se* contradictory, if one ever had that notion, but the gain in drawing a parallel between "the structure of the number series and the bare skeleton of the ideal self"[15] is not so evident. Philosophers have not been brought to perfect agreement even as to the advisability of asserting that "the Absolute is a Kette."[16] There is certainly a suspicion possible that this mathematical concept, defined in a specific sense, is not significant, even if correctly taken over into philosophy.

III

Mathematical method, as such, is suited only for a critique of a developed system.

Dr. Karl Schmidt in an interesting paper in this JOURNAL[17] has presented the thesis that the most important thing for present-day philosophy to do is to "make up its mind" concerning certain philosophic issues, *i. e.*, get definite "generating problems" and develop them into a philosophy. When developed the same able thinker has

[15] "World and the Individual," Vol. I., p. 527.

[16] *Idem*, p. 546.

[17] 1909, pp. 673–685.

proposed a Critique of Cognition that may be applied to them.[18] This critique has been developed from the study of scientific method but not taken over from it. With this procedure the present writer is in entire sympathy. Therefore, if there is to be a realistic platform, the agreement should be primarily one of fundamental opinions. The method of the development is insignificant compared with the attainment of results, and as Dr. Schmidt has so clearly seen, the logico-mathematical form is suited to criticism only, not to development.

Suppose it were made the method of development. Let us assume that realists are agreed on a complete set of postulates. Their task is then to deduce the consequences of these postulates, manipulating them according to the laws of the system of formal logic agreed upon. The result would be worse than the worst type of scholasticism. Either ethical, political, sociological, and religious views are independent of philosophy—and in that case what significance can philosophy claim?—or else the realists would all say the same things about these issues. What a dull place the world would be if every one were converted to the cause! Each man's life would be playing his part in realizing the deduced consequences of realistic postulates. Common points of view, tendencies, are healthy; but mathematical agreement of opinions is disease.

And the sole method of philosophy would be dialectic, although dialectic has never convinced anybody. It has silenced many. Professor Royce founds his system on irrefutable dialectic—on propositions the very denial of which reaffirms them. But Professor Spaulding[19] refutes him. It would be an interesting exercise in dialectic to refute Professor Spaulding in turn. It is probably possible, as no dialectic argument in the history of philosophy has ever won uniform assent from those to whom it was addressed, and they have not always been dull.

The above comment suggests the sad conclusion that philosophers must do the work of philosophy. No other science is going to do it for them. However complex or however simple concepts may be, their form must be studied in relation to the facts they are intended to interpret. The great merit of Kant is that he made up his mind as to his "generating problem" and adapted his method to its solution. The solution has difficulties, but it is great. We reject it, not because it is bad philosophy, but because his "generating problems" are not ours. If our civilization resembled more closely that of Kant's country and day it would be a different story.

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[18] *Idem*, pp. 281–287.

[19] *Phil. Rev.*, Vol. XIX., No. 3, 1910, pp. 276–301.

And perhaps the unclearness of philosophy that so troubles the realists is not due to the fact that we have not absorbed mathematical logic, or any other science, but arises because we have allowed sciences, cuckoo like, to lay their eggs in our nest and have unresistingly brooded upon them until the hatchings startled us from our lethargy. By all means we should aim at clearness, precision, and all the other virtues—we have, all of us, too few of them. And we need to know as much about the achievements of science as is possible. But the conceptual synthesizing which must interpret this knowledge and make it into philosophy—for no mere heap of knowledge is philosophy—is the work of the philosopher and his concepts must be adapted to its specific needs. It is time to seek philosophic problems and philosophic methods for the philosopher.

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REVIEWS AND ABSTRACTS OF LITERATURE

Esthetic as Science of Expression and General Linguistic. BENEDETTO CROCE. Translated by DOUGLAS AINSLIE. London: Macmillan & Company. 1909. Pp. xxxi + 403.

Mr. Ainslie has translated the whole of the theoretical part of Croce's "Estetica" and has presented in English an abbreviation of the historical part. An appendix contains a translation of an address on "Pure Intuition and the Lyrical Character of Art," delivered by Signor Croce at Heidelberg at the Second General Session of the Third International Congress of Philosophy. This lecture includes a brief presentation of Croce's theory and might well be read before the larger work. The translator's introduction to the "Æsthetic" is a glorification of Croce and all his works. He is hailed as "one of the very few great teachers of humanity." His "Logic" and his "Philosophy of the Practical," which, with the "Esthetic," make up his "Philosophy of the Spirit," are praised in the highest terms. He is the "Columbus" of esthetics. Signor Croce is known to English readers as a critic of the first rank and as the author of a work on esthetics which has attracted much attention, but few were prepared to hear him praised in such extravagant language.

For the most part the translation is very close to the original, in fact it is almost literal. There are, however, occasional departures which modify somewhat the meaning of the author, as, for example (p. 18), where the expression "indifferente alle discriminazione posteriori ed empiriche della realtà ed irrealtà" by "indifferent to discriminations, posterior and empirical, to reality and to unreality."

On the other hand, faithfulness to the original can hardly justify a sentence which begins, "It is from human psychology, that is, literary psychology, that comes the other objection, to the effect," etc. And it is